Commonwealth of Massachusetts
Department of Telecommunications and Energy
Fitchburg Gas and Electric Light Company
Docket No. D.T.E. 02-24/25
Record Request Response

Record Request No.: AG-RR-51

a. Provide a copy of all reports discussing the fire at the Sawyer Passway substation;

b. Provide a copy of the Sawyer Passway electric distribution study;

c. Provide any other studies that describe why the Sawyer-Passway substation was needed.

Response:
Regarding the fire at the old Sawyer Passway [Electric Station] substation, the following attachments are provided:

Attachment a1:	Memo from T. Gatherum, dated March 12, 2000 Fire - Sawyer Passway Switchgear - 3/12/00 Re: Property Insurance Coverage
Attachment a2:	City of Fitchburg Fire Department Field Incident Report
Attachment a3:	FG&E Electric Station Switchgear Failure Event Analysis Report

In response to question b, which refers primarily to the design of circuit exits emanating from the new substation, as referenced in Authorization 1084, the following reports are provided:

Attachment b1:	Sawyer Passway Substation Distribution Circuits "Design of Distribution Circuit Exits and Interconnections for Fitchburg Gas and Electric Light Company", Janet Kowalski, August 2000.
Attachment b2:	Sawyer Passway Distribution Exit Strategy, Final Recommendation. Dated January 9, 2001.

In response to question c, which refers to studies that describe the need for a new substation at Sawyer Passway, the following reports are provided:

Attachment c1:	Sawyer Passway Distribution Study, Capital Budget Project Summary, 8/19/99
Attachment c2:	Sawyer Passway Distribution Study, Kevin E. Sprague, 9/7/99.

The final attachment c2, the "Sawyer Passway Distribution Study", includes and incorporates earlier reports that laid the groundwork for a new substation at Sawyer Passway. This included an "Electric Station Planning Study for Fitchburg Gas and Electric Light Company", prepared by Parsons Power Group in April, 1997. Also included is a #8 Feeder Study prepared in March of 1996. Both of these reports are included in the report under Attachment c2.

Person Responsible: Mark H. Collin

DATE: March 12, 2000
SUBJECT: Fire – Sawyer Passway Switchgear – 3/12/00
Re: Property Insurance Coverage
FROM: T. Gatherum
TO: M. Dalton, R. Bisson
Cc: M. Collin

I have viewed the damaged switchgear involved and have completed a review of the insurance policies that might provide coverage to FG&E for the damages it sustained. It is my opinion that there will be no or little recovery for FG&E from its insurers for this damage.

There are two (2) policies that might provide coverage: (a) the Boiler & Machinery ["B&M"] policy issued by the Royal & Sun Alliance, and (b) the All Risk Property ["ARP"] policy issued by Starr Technical Risks Agency. All policies provide coverage to property at locations listed in the schedule of locations, unless certain properties at a location are specifically excluded, or the damage results from an excluded peril (that, which causes the damage).

The B&M policy essentially provides coverage for damages caused by perils which arise within the equipment itself. As its name implies, it is most applicable to boiler or other pressure vessels and mechanical equipment. Electrical "disturbances" are included as a peril. The B&M policy includes Sawyer Passway as a location, it specifically excludes "... the fossil fuel steam plant located at Sawyer Passway, Fitchburg, MA." and "... all substations except Flagg Pond, [and the three mobiles in the Unitil System]..." Therefore, although the peril is covered, the property is excluded from coverage. The intent was/is to insure the gas equipment at this location only. Previously, the gas turbine generator and compressor station were included, but they were removed from the schedule when FG&E gave up its interest in them.

The decision to exclude the bulk of the electrical equipment from B&M coverage has evolved over the past decade. Prior to the mid-eighties we (the Unitil System companies) did not carry B&M coverage on electrical equipment except for generation facilities. We explored the coverage in the mid-eighties when we were experiencing a rash of substation transformer failures (including a number with aluminum winding at CECO). The coverage at that time was about $5,000 per company and deductibles were in the $5,000 range. Replacement transformers were in the range of $50,000 – $75,000 and we replaced several at each company. This was a good deal but couldn't last forever, and didn't. Soon the premium skyrocketed and the carriers were placing maintenance conditions on continued coverage (such as monthly gas analysis, etc). We went through four (4) carriers in fifteen (15) years. The deciding factor on not carrying the coverage however was the Actual Cash Value endorsement added by the carriers for any equipment over 25 years of age. It provided that instead of replacement costs, the carrier would only pay "... the amount to repair or replace the property ... less allowance for physical deterioration and depreciation, including obsolescence."

The ARP policy, while providing coverage for the location, specifically excludes coverage for the peril of "electrical failure, electrical injury or disturbance to electrical appliances, [etc.] ..." It

does however provide coverage for "... ensuing fire ... and then only for the actual loss or damage directly caused by such ensuing fire ..." My preliminary observation of the damaged equipment leads me to believe that the vast majority of the damages were electrical in nature and not "ensuing fire". This is based primarily on the fact that there appears to have been very little combustible material available to support such fire.

My plan at this time is not to notice the B&M carrier as I see no potential for recovery there and am not interested in providing this information to there underwriters shortly before renewal (5/1/00) if there will be no recovery.

I am still putting my thoughts together with respect to involving the ARP carrier. This policy also renews 5/1/00. One option I am contemplating would be to bring in a cause and origin expert (cost = $600 - $750) prior to noticing the carrier. I would open up one of the adjacent compartments that incurred little damage (primarily heat) and seek his opinion as to the amount and types of combustibles present and whether they would support an "ensuing fire" theory. If such a theory could be supported, it must be remembered that only that portion of damages directly attributable to "ensuing fire" could be recovered.

Please let me know your thoughts regarding the above option.

CITY OF FITCHBURG
FITCHBURG FIRE DEPARTMENT
FIELD INCIDENT REPORT

PAGE: 1 OF: 1

INCIDENT #: 00-1655

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NARRATIVE SUPPLEMENT

: ENGINE 6 TO SAWYER PASSWAY, ASSIST OTHER CREWS AT THE UNITIL POWER PLANT BUILDING ELECTRICAIL EQUIPMENT FIRE. E6 CREW OPENED CABINET DOOR PANELS FOR BETTER ACCESS WITH HOSE LINES. E6 CREW DID OVERHAUL WORK, AND TURNED OVER CONTROL OF BUILDING TO UNITIL ON SCENE, DEPARTED AT 0915 HRS.

PVT. DOUGHTY
PVT. HYVARINEN

REPORTING OFFICER: CAPT. RALPH C. ALARIO DATE: 3/12/00

APPROVED BY: DATE:

CITY OF FITCHBURG
FITCHBURG FIRE DEPARTMENT
FIELD INCIDENT REPORT

PAGE: 1 OF: 1

INCIDENT #: 00-1655

NARRATIVE SUPPLEMENT:

: E-1 WAS SENT TO SAWYER PASSWAY ON A SMELL OF SMOKE FROM THE POLICE. WHEN WE ARRIVED WE OBSERVED SMOKE COMING FROM THE ROOF. UNITIL EMPLOYEE R. COURTEMANCHE AND LT. SHEA ENTERED THE BUILDING TO DETERMINE WHAT WAS BURNING. WE FOUND A SWITCHING CABINET ON THE SECOND FLOOR FULLY INVOLVED. WE HAD ALREADY STRETCHED A LINE AND WERE AWAITING CONFIRMATION OF A POWER SHUT OFF. UNITIL COULD NOT GUARANTEE APOWER SHUT OFF SO WE BACKED OUT AND WAITED FOR FURTHER INSTRUCTIONS. C-300, L-3 AND E-3 HAD ARRIVED BY THIS TIME. TWO HOURS PASSED BEFORE POWER WAS SHUT DOWN AND WE REENTERED TO EXTINGUISH. E-1 PERSONNEL USED THREE TANKS EACH BEFORE BEING RELEIVED. PVT. SELINGA INJURED TWO FINGERS ON HIS RIGHT HAND IN THE PROCESS OF EXTINGUISHMENT.

LT.M.J. SHEA
PVT. SELINGA
PVT.DURRIN

COPY

:EPORTING OFFICER: SHEA,M.J. LT. E-1 DATE: 3-12-00

.PPROVED BY: DATE:

CITY OF FITCHBURG
FITCHBURG FIRE DEPARTMENT
FIELD INCIDENT REPORT

PAGE: 1 OF: 1

INCIDENT #: 00-1655

NARRATIVE SUPPLEMENT: SAWYER PASSWAY

: ENGINE 3 RESPONDED TO SAWYER PASSWAY ON A SPECIAL CALL FROM D.C. TESTAGROSSA. ENGINE 3'S ENGINE COMPANY DONNED MSA'S AND ASSISTED ENGINE 1'S CREW PLAY DRY CHEMICAL ON A BURNING ELECTRICAL SWITCH CABINET. THE DRY CHEMICAL EXTINGUISHERS WERE NOT EFFECTIVE AND COMPANIES RETREATED. AFTER 2 MINS FITCHBURG GAS AND ELECTRIC LIGHT CO. EMPLOYEES ASSURED US THAT POWER WAS DISCONNECTED TO THE BURNING SWITCH ROOM AND IT WAS SAFE TO USE WATER AS AN EXTINGUISHING AGENT.
ENGINE 3'S CREW ADVANCED AN 1-3/4 PRECONNECT LINE FROM ENGINE 1 INTO THE SWITCH ROOM AND KNOCKED DOWN FIRE IN 4 SWITCH CABINETS.
ENGINE 1 MADE UP AT CENTRAL AND ASSISTED OTHER CREWS.

PVT. BURKE
PVT. JOLLIMORE

COPY

REPORTING OFFICER: ACT. CAPT S. CASTELLI DATE: 3-12-00

APPROVED BY: DATE:

COPY

MASSACHUSETTS FIRE INCIDENT REPORT (FP-32) FITCHBURG FIRE DEPARTMENT PAGE 1

A	FDID 27097	INCIDENT# 00-001655	EXP# 00	DATE 03/12/00	DAY OF WEEK SUNDAY	ALARM TIME 02:31	ARRIVE TIME 02:38	IN-SERVICE 04:18
B	TYPE OF SITUATION FOUND STRUCTURE FIRE | 11				TYPE OF ACTION TAKEN EXTINGUISHMENT | 1		MUTUAL AID	
C	FIXED PROPERTY USE (Occupancy) ELECTRIC DISTRIB | 642					IGNITION FACTOR FACTOR UNKNOWN | 00		
D	CORRECT ADDRESS 1 SAWYER PW					ZIP 01420	CENSUS 7101	
E	OCCUPANT NAME					TEL	ROOM N/A	
F	OWNER NAME UNITIL ELECTRIC			OWNER ADDRESS			OWNER TELEPHONE#	
G	METHOD OF ALARM FROM PUBLIC TELEPHONE/TIE-LINE | 7			DISTRICT 04		SHIFT 3	NO. OF ALARMS 1	
	HAZARDOUS MATERIAL PRESENT? NO					SUBSTANCE		
H	NUMBER OF FIRE PERSONNEL RESPONDED 15	NUMBER OF ENGINES 004		NUMBER OF AERIAL APPARATUS 001		NUMBER OF TANKERS	NUMBER OF OTHER VEHICLES RESPONDED 001	
I	FIRE SERVICE INJURIES	FATALITIES		OTHER INJURIES		FATALITIES	RESCUES	
J	MOBILE PROPERTY TYPE MOBILE TYPE N/A | 08					INSURANCE COMPANY		
	VEHICLE STOLEN? NO	ESTIMATED TOTAL DOLLER LOSS				TOTAL INSURANCE	CLAIM PAID	
	YR / MAKE	MODEL		COLOR		LICENSE#	VIN#	
	IF EQUIPMENT INVOLVED IN IGNITION	YEAR		MAKE		MODEL	SERIAL#	
K	COMPLEX POWER PROD COMPLEX | 61			AREA OF ORIGIN SWITCHGEAR/TRNSFRM | 63		EQUIP INVOLVED IN IGNITION EQUIP UNDETERMINED | 00		
L	FORM OF HEAT IGNITION UNDETERMINED | 00			FORM OF MATERIAL IGNITED FURNITURE NO INFO | 20		TYPE MATERIAL IGNITED OIL COMPOUND-UNKNO | 80		
M	METHOD OF EXTINGUISHMENT PRECONN HOSE HYDRN | 6					LEVEL OF FIRE ORIGIN 10 TO 19 FEET | 2		
	NUMBER OF STORIES 3 TO 4 STORIES | 3					CONSTRUCTION TYPE PROTECTED ORDINARY | 5		
N	EXTENT OF DAMAGE - FLAME ROOM OF ORIGIN | 3					SMOKE CONFINED TO STRUCTURE OF | 6		
O								
P	DETECTOR PERFORMANCE NO DETECTORS | 8					SPRINKLER PERFORMANCE EQUIP NOT PRESENT IN RM/SPACE | 8		
Q	IF SMOKE SPREAD BEYOND ROOM OF ORIGIN	FORM OF MATERIAL GENERATING MOST SMOKE POWER, FUEL N/CLASS | 69				Entries contained in this report are intended for the sole use of the State Fire Marshal. Estimations and evaluations made herein represent "mostslikely" and "most probable" cause and effect. Any representation as to the validity or accuracy of reported conditions outside the State Fire Marshal's office, is neither intended nor implied.		
		TYPE OF MATERIAL OIL TREATED NO INF | 80						
R		AVENUE OF SMOKE TRAVEL STAIRWELL | 4						
	MEMBER MAKING REPORT (NAME, POSITION, ASSIGNMENT) TESTAGROSSA, G. ADC C-300					PHONE	DATE 03/12/00	

FDID	INCIDENT#	EXP#	DATE	DAY OF WEEK	ALARM TIME	ARRIVE TIME	IN-SERVICE
27097	00-001655	00	03/12/00	SUNDAY	02:31	02:38	02:38

NFIRS BACK PAGE

Notify following agencies...

NARRATIVE:
ENGINE 1 WAS DISPATCHED TO SAWYER PASSWAY ON AN OVERHEATED ELECTRICAL SMELL, POSSIBLY A TRANSFORMER. THEY CALLED FOR C-300 AND ON ROUTE ALL THE POWER ON MAIN STREET WAS OUT. ON ARRIVAL I CALLED FOR A FULL FIRST ALARM RESPONSE AND UNITIL WAS ALREADY ON SCENE WITH SEVERAL TRUCKS. ENGINE 1 AND 3 CREWS ENTERED THE BUILDING AND RETURNED STATING THAT THERE WAS HEAVY SMOKE ON THE SECOND FLOOR TRANSFORMER ROOM. LT SHEA AND CAPT CASTELLI SUGGESTED THAT WE TRY SEVERAL DRY CHEMICAL EXTINGUISHERS TO KNOCK DOWN THE FIRE. IT WAS KNOCKED DOWN BUT WOULD NOT EXTINGUISH. UNITIL EMPLOYEES, CINDY RIVERS, SHIFT MANAGER, AND STEVE BAKER, SHIFT FOREMAN COULD NOT TELL US IF THE POWER WAS SHUT DOWN. THEY DID FIND THAT THE POWER WAS BACK FEEDING FROM SEVERAL DIFFERENT PLACES AND IT COULD TAKE SOME TIME TO SHUT THEM ALL DOWN. I PULLED ALL PERSONNEL OUT AND WAITED. I CALLED 10C AND HE RESPONDED. WHEN WE GOT THE OK FROM UNITIL EMPLOYEES, ROB COUTERMARSH AND MARTY SIMONEAU, WE ENTERED THE SECOND FLOOR WITH A 1 3/4 PRECONNECT. E1 AND E3 CREWS KNOCKED DOWN THE SMOLDERING FIRE IN THE ELECTRICAL TRANSFER CABINETS. THERE WERE TEN CASES IN ALL AND EACH ONE WAS DIFFICULT TO OPEN. EACH ONE WAS ABOUT 4 FEET WIDE AND 8 FEET HIGH. WE TOOK A SECOND PRECONNECT FROM E1 AND LAID A 4 INCH FEEDER LINE FROM THE HYDRANT. THE SECOND LINE WENT TO THE BASEMENT TO KNOCK DOWN SOME SMOLDERING EMBERS THAT HAD FALLEN FROM ABOVE. WE THEN USED THIS SECOND LINE IN CONJUNCTION WITH THE FIRST TO FINNISH OV

ERHAULING THE TRANSFER CABINETS. L3 PUT THE AERIAL TO THE ROOF BUT WE DID NOT VENTILATE AS UNITIL STATED THAT IT WAS CONCRETE SLAB AND WAS SHORED UP FROM THE UNDER SIDE DUE TO FAILURE. WE TOOK THE AERIAL DOWN AND L3 USED THE PPV FAN TO ASSIST IN VENTING. ENGINE 6 AND ENGINE 4 RESPONDED TO RELIEVE THE ENGINE 1 AND 3 CREWS FOR OVERHAUL. L3 PICKED UP WHEN THE LIGHTING TRUCK ARRIVED. WE HAD USED 2 CIRCLE D LIGHTS FROM L3. THE DEP WAS CALLED AND A MR NICK CHILDS RESPONDED AND STATED THAT THERE WAS NO PROBLEM AT THE SITE DURING THE FIRE. ALL MSA'S FROM ALL PIECES WERE USED AND ALL SPARE BOTTLES. WE FILLED THEM ON SITE FROM THE LIGHTING TRUCKS CASCADE SYSTEM. ALL COMPANIES RETURNED FROM THE SCENE EXCEPT ENGINE 3 PERFORMING FINAL OVERHAUL.

FG&E Electric Station Switchgear Failure
March 12, 2000
Event Analysis Report

FG&E Electric Station Failure, March 12, 2000
Event Analysis Report

Introduction:
At approximately 01:55 on Sunday March 12, 2000 the 13.8kV Bus #2 Switchgear at the Electric Station faulted and caught fire. The Bus fault caused the loss of all loads served from Summer St. substation and Electric Station. A total of 5609 customers were out of service with the last customer being re-energized at approximately 19:10. The fire destroyed the Bus #2 Switchgear.

At the time of the fault, a thunderstorm was traveling through the area.

At approximately 2:00 A.M. the Lunenburg police department notified Fitchburg Gas and Electric (FG&E) that there was no power in the Summer Street area. A few minutes later, the FG&E dispatcher also received an intruder alarm at the Electric Station. The dispatcher then notified the on call supervisor, Cindy Rivers. The police department and the FG&E Substation supervisors were also notified and requested to provide support at the Electric Station.

Cindy Rivers arrived at the Electric Station with the police at approximately ten minutes after notification. On first arrival at the Electric Station, Ms. Rivers noticed the area and building were out of power. No smoke could be detected at that time. She then entered the building to shut off the alarm and escorted the police into the building. When she opened the stairway door, she noticed smoke from the floor above and notified the fire department and a near-by line crew.

At this time the Substation Team Leader, Steve Baker, arrived and entered the building with a line crew member to investigate the condition of the system. Mr. Baker stated that due to the thick black smoke, there was very little visibility, but he was able to duck low under the smoke. Entering the Lower switchgear room, Mr. Baker found the point where the fire was burning the hottest. He stated that the metal was glowing red hot. He then attempted a number of times to extinguish the fire at that spot with portable fire extinguishers. When these attempts failed, Mr Baker concentrated on electrically isolating the switchgear bus so the fire department could hose the fire with water to cool it down.

While the Switchgear was being isolated from Bus #1 at Electric Station, the Technical Systems Manager, Patricia Stagno, isolated the Electric Station from the Summer Street substation.

After the switchgear was de-energized and isolated, the fire department started to hose down the fire at approximately 05:45.

During this time other Unitil crews and personnel were requested to come in to offer support. While the fire was being extinguished at the Electric Station, the restoration team started switching procedures to restore as many customers as possible from other station supplies.

Appendix A contains a table detailing the sequence of events during the fault and the restoration occurring Sunday March 12,2000.

Restoration Switching:

The Summer St Load was restored at 03:36 when the Feeders 3A and 9 were opened manually and Transformer Secondary B123 breaker was manually closed. This action restored 831 customers 1 hour – 42 minutes after the event.

At Approximately 08:00 the fire at Electric Station was extinguished.

At Nockege Substation, the spare recloser controller was installed into the Feeder 1A recloser to allow closing of the recloser. At 08:08 the Nockege substation was energized via the Feeder 1A. Circuits 22, 23, 24, and Feeder 17 were re-energized to restore power to 954 customers, 6 Hours and 11 Minutes after the initial event.

At approximately 08:56, Circuit 1 was tied to Circuit 10, emanating from Canton St., to restore 629 customers 7Hours – 2 Minutes after the initial outage.

At 09:16, Circuit 9 was connected to Circuit 35 to restore 370 customer after 7 Hours and 22 Minutes.

All Control and power connections between Bus #1 at Electric Station and Bus #2 were removed to fully isolate Bus # 1 from the faulted bus. Bus #1 and Feeder 9 were then High Potential tested. The Station Service Transformer #4 was cut clear from Bus #2 and was connected through fused cut-outs to Feeder #9. The 4kV Transformer #6 was also cut clear from Bus #2 and connected to Feeder 3A through Fused cutouts.

At 16:40, Feeder #9 breaker was closed at Summer Street Substation to re-energize Bus #1 at Electric Station the Station Service Transformer #4. This action energized 992 customers on the 13.8kV downtown network. The total outage duration for the 13.8kV network was 14 Hours and 46 Minutes.

At approximately 19:00 Feeder 3A breaker at Summer Street substation was closed to energize the 4kV transformer #6 at the Electric Station. Then between the time of 19:02 and 19:11, the breakers for 4kV Circuits 4, 13, and 2 at Electric Station were closed to re-energize each circuit. The outage duration for Circuits 4, 13, and2 were 17 Hours – 8 Minutes, 17 hours – 12 Minutes, and 17 hours 17 Minutes respectively. The re-energization of the 4kV circuits from Electric Station restored power to the last customers.

Due to low Voltage on Circuit 10, Circuit 1 had to be cleared from Circuit 10 and re-energized from it's normal supply; the Electric Station, at approximately 20:50.

Final System Configuration:

After all restoration was completed the temporary system configuration was as follows:

- Feeder 9 from Summer St. supplied the Electric Station 13.8kV Bus #1 and the Station service transformer. The Station service transformer was tapped directly to the Feeder 9 through a set of Fused cut-outs.
- The 4kV transformer at Electric Station was supplied directly by Feeder 3A from Summer St.
- Line 06 was left de-energized from the open breaker at Summer St.
- The Nockege substation was supplied from Feeder 1A emanating from the Wallace Rd substation, instead of it's normal supply of Feeder 10 and Feeder 17 from Electric Station.

Appendix C displays the temporary configuration of the system as it exists after the restoration. The system is left in this temporary configuration until more permanent repairs can be performed.

Relaying Operation Analysis:

Visual inspection of the damaged switchgear showed the extensive mechanical and electrical damage to the switchgear. The copper bus bar was distorted by the heat and numerous breakers and insulators were destroyed. It is difficult to determine what damage was caused by the electrical fault and what damage was caused by the fire. However, inspection of the switchgear does indicate that there was a fault inside the switchgear in the vicinity of the Feeder 17 cubicle, possibly initiated by a failure inside a breaker.

For a fault inside the switchgear, the fault should have been isolated by the following breakers opening:

- The Neutral or Phase Overcurrent relay on Feeder 3A at Summer Street should have operated to trip the Feeder 3A breaker.
- The Neutral or Phase Overcurrent relay on Feeder 9 at Summer Street should have operated to trip the Feeder 9 breaker.
- The 13.8kV Phase Overcurrent relay on the Line 06 Transformer at the Electric Station should have operated to trip the Line 06 Secondary Breaker.
- The 13.8kV Phase Overcurrent relay on the Station Service Transformer T4 should have operated to trip the T4 13.8kV breaker.

The SCADA alarms at Electric Station indicate that at 01:54:08 the Line 06 transformer secondary Breaker tripped. This breaker was tripped by a correct operation of the Phase Overcurrent relay. During the same scan SCADA reported the Transformer T4 13.8kV breaker tripped. The T4 primary Overcurrent relays operated correctly to trip the breaker.

At Summer Street, the Transformer Neutral Overcurrent relay operated at 01:53:14 to trip the transformer secondary breaker and de-energize the 13.8kV bus. This is evident by the loss of Logger #1 Alarm (loss of Power at John Fitch Highway) on the SCADA alarm list. This relay operated correctly per its setting. However, the setting miscoordinated with the settings of the Feeder 3A and Feeder 9 relays.

A coordination study revealed that the settings of the Transformer Neutral Overcurrent relays at Summer St. miscoordinate with the Neutral Overcurrent relays on Feeder 3A and Feeder 9. Appendix D show the time current curves of the present relay settings. The present settings of the Phase Overcurrent relays coordinate well.

Recommendations:
The Protection, Control, and Measurements Team recommends the following work be performed.

1. The settings of the Summer St. Transformer Phase and Neutral Overcurrent relays should be revised to coordinate with the 13.8kV feeder relays. The proposed settings are attached to this report as Appendix E.
2. The existing relays on Feeders 3A and 9 at Summer St. should be tested according to the relay setting test values attached in Appendix E of this report.
3. The Feeder 1A recloser was set with a temporary setting to allow the restoration of service. This recloser should be reset and tested per the setting sheet attached in Appendix E.
4. A relay coordination study should be performed for the Electric Station area.
5. Recommendations to reconfigure the system to a more permanent solution will be provided in a separate report. There will be additional recommendations to install other relays during this time.

Conclusion:
During the early morning hours of Sunday, March 12, 2000, a thunderstorm passed through the Fitchburg and Lunenburg area. A fault occurred within the Bus #2 13.8kV switchgear at Electric station. To isolate the fault, the Neutral Overcurrent relay on the Summer Street transformer operated to trip the transformer B123 breaker and de-energize the 13.8kV bus. The Line 06 Overcurrent relays at Electric Station operated to trip the associated breaker and isolate the fault.

Although the relays at Summer St isolated the fault, the severity of the fault caused the switchgear to catch fire which could not be extinguished until after 07:00.

A total of 5609 customers lost power due to this fault. The restoration of load which could be supplied from other sources began immediately while the fire was

being extinguished. After the Electric Station fire was extinguished, efforts were concentrated to re-energize the 13.8kV network and the 4kV load emanating from the Electric Station. The last customer was re-energized at 19:11 on March 12, 2000.

After the fault, the electric system was restored to a temporary, but stable configuration. A more permanent configuration has been designed and will be detailed in a separate report.

Prior to reconfiguring the system, the Summer St. Transformer Neutral Overcurrent relays should be reset per the settings attached in Appendix E. The Feeder 3A and Feeder 9 relays should also be tested per the attached setting sheets.

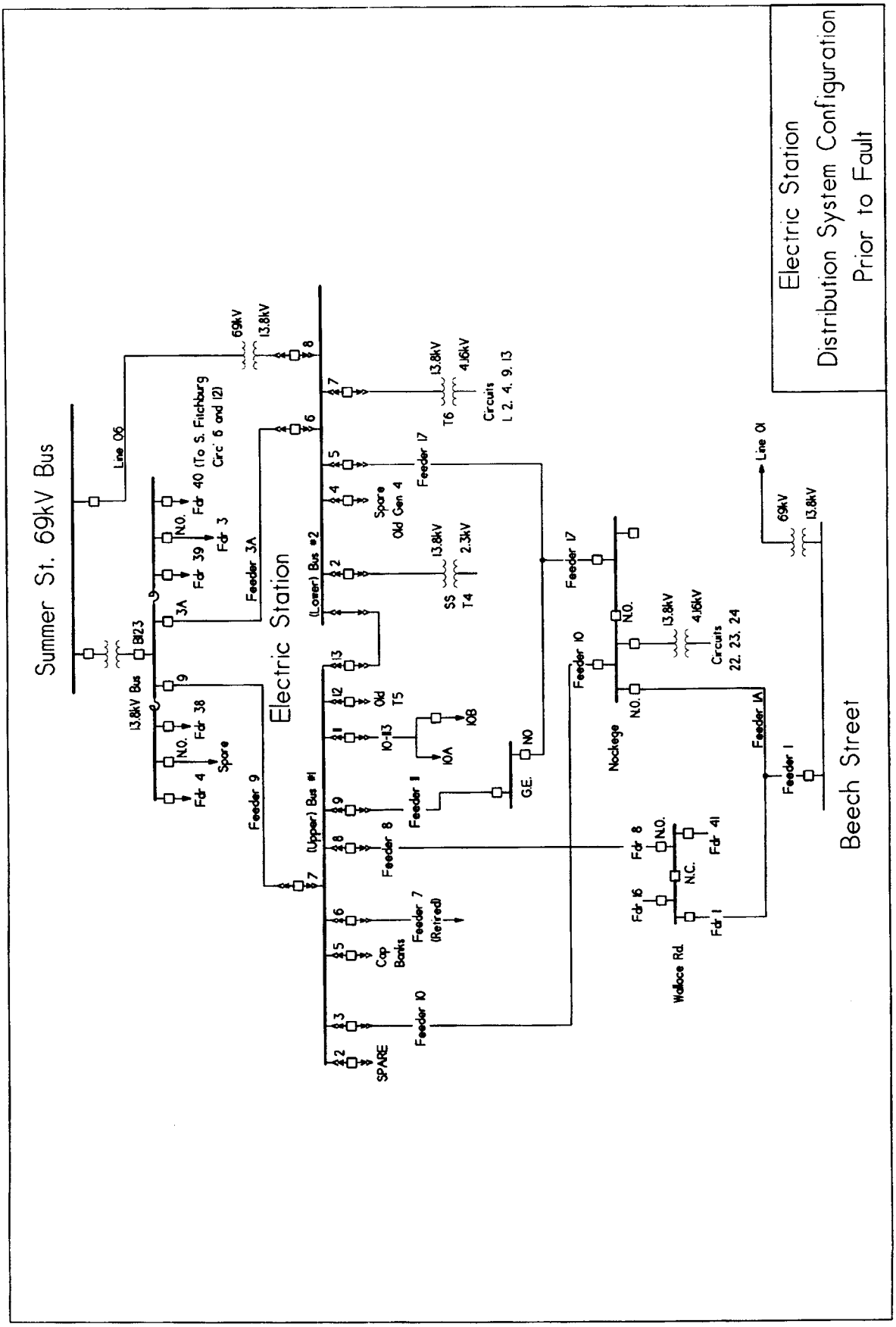
Appendix A
Sequence of Events

Sequence of Events

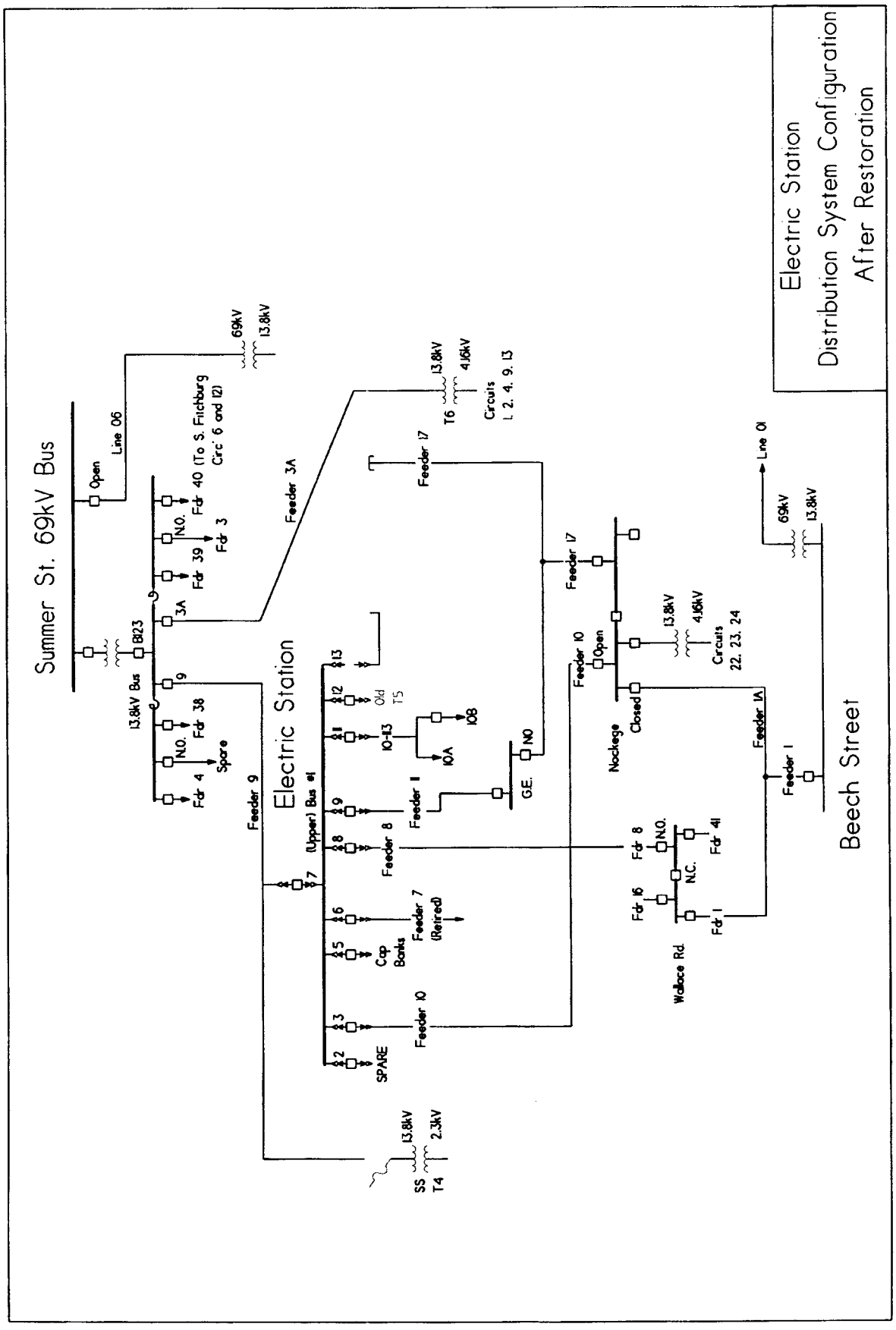
Time	Event
01:53:14	SCADA alarms indicate Loss of Power at John Fitch Highway office.
01:54:	SCADA alarms indicate #6 Gen. transformer Breaker and #4 Station Service Transformer Breaker at Electric Station tripped. The Bus volts on Bus #1 and Bus #2 Dropped to 0 Volts.
02:00	Lunenburg Police Dept. indicate that there is no power in Summer St. area. Dispatcher notifies on-call supervisor of outage and an intruder alarm at the Electric Station.
02:11	On call supervisor arrives at Electric Station and enters to notice smoke. Fire Department is notified.
02:11	Dispatcher notified Technical System Manager and Substation Team Leader for assistance.
03:36	The Transformer secondary breaker B123 was found opened and was manually closed to re-energize the 13.8kV bus at Summer St The following targets were recorded from Summer St.: Ground Overcurrent Instantaneous target on Feeder 3A. Ground Overcurrent Instantaneous target on Feeder 9, Neutral Overcurrent trip target on B123 Breaker. Breaker B123 was Open.
	Substation Team Leader enters the Electric Station isolates the faulted bus for Fire Dept.
05:45	Fire Dept. starts to hose the fire with water..
08:08	Nockege substation re-energized through Feeder 1A
08:57	Circuit 1 restored
09:16	Circuit 9 restored
16:40	Electric Station Bus #1 re-energized via Feeder 9 and Downtown Network restored
19:03	4.16kV Transformer T6 at Electric

	Station re-energized via Feeder 3A
19:05	Circuit 4 restored
19:06	Circuit 13 restored
19:11	Circuit 2 restored
20:50	Circuit 1 disconnected from circuit 10 and reconnected to Electric Station.

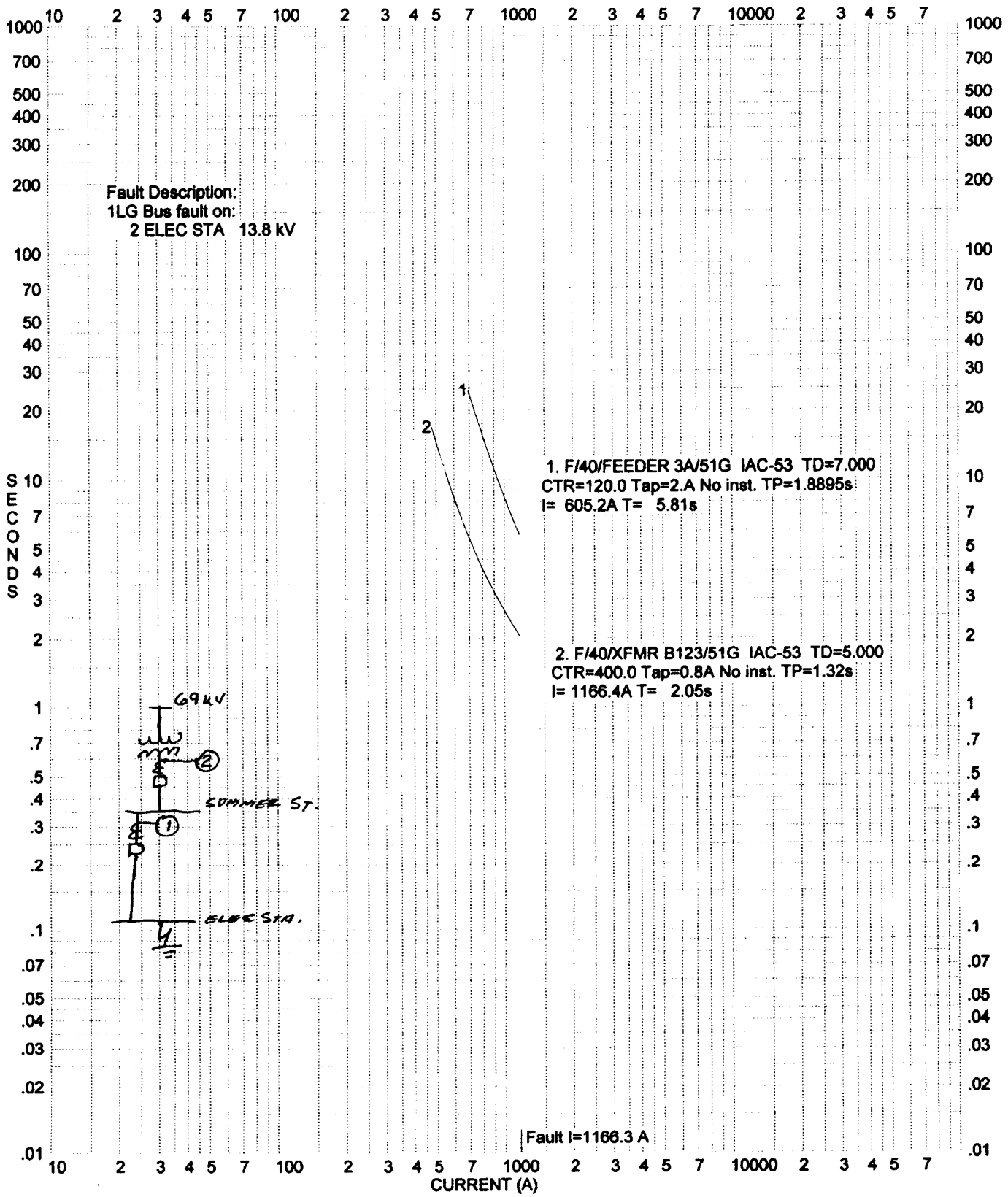
Appendix B
Electric Station Area configuration Prior to Fault



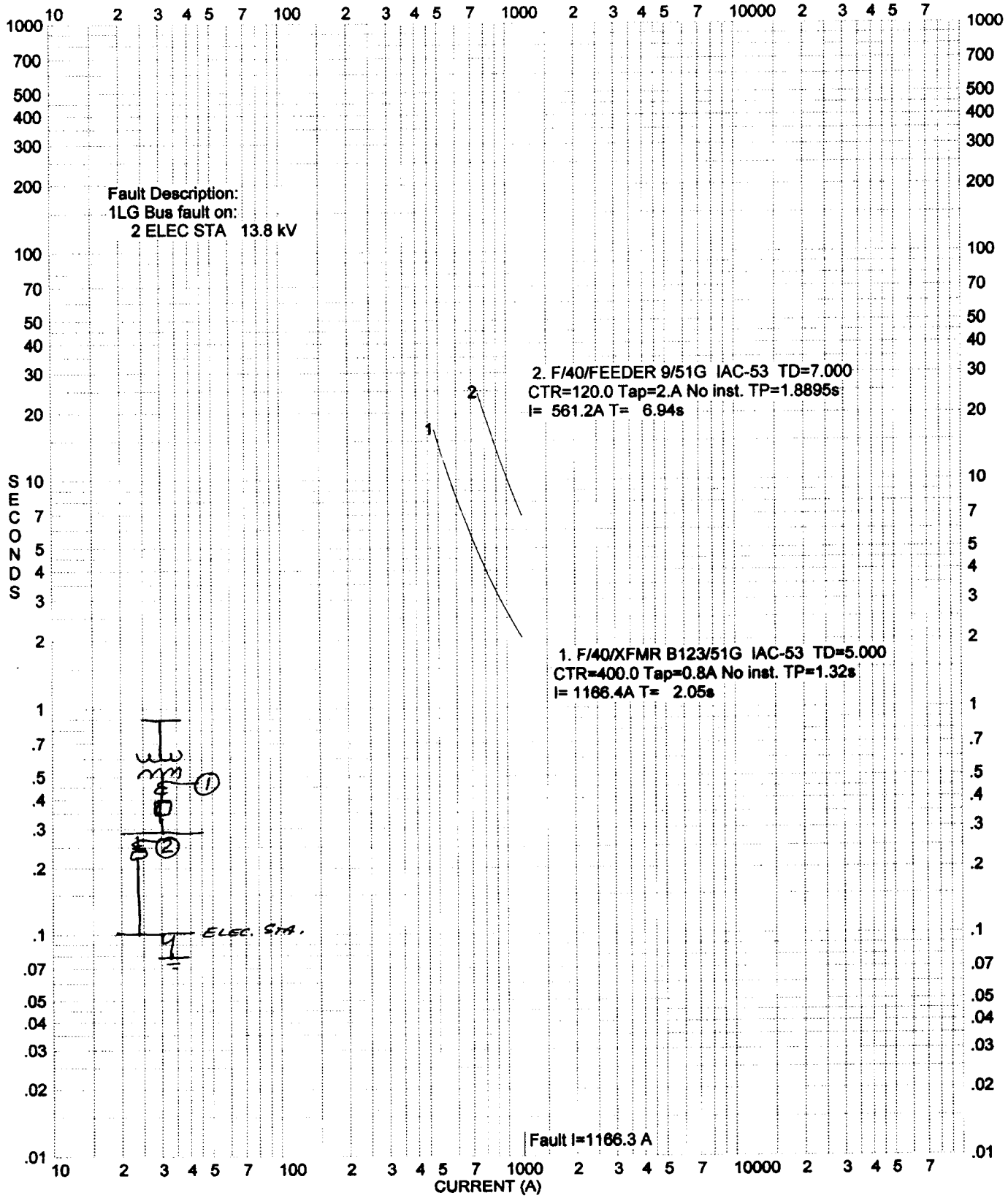
Appendix C
Electric Station Area configuration After Restoration



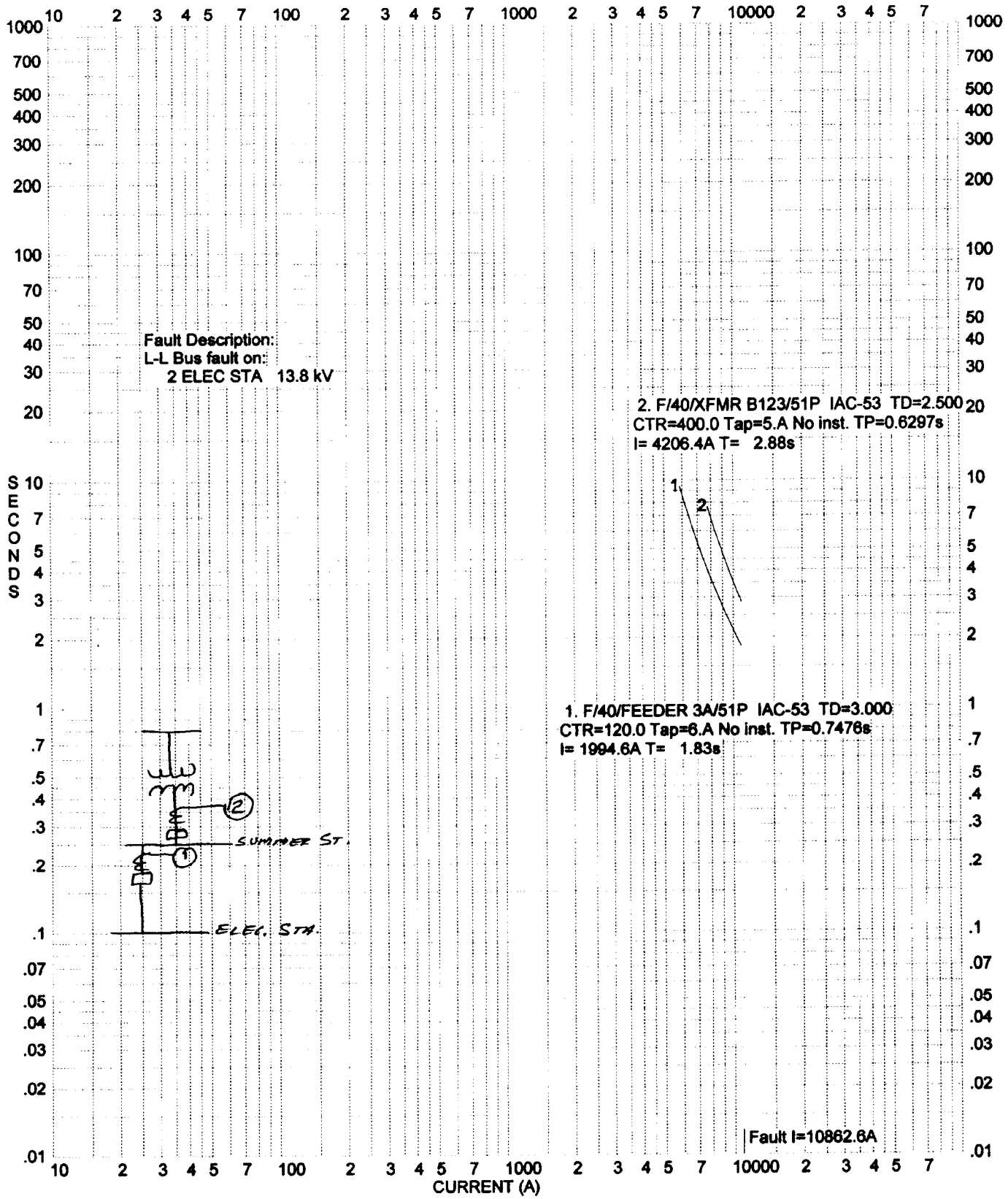
Appendix D
Exisitng Relay Time-Current Curves



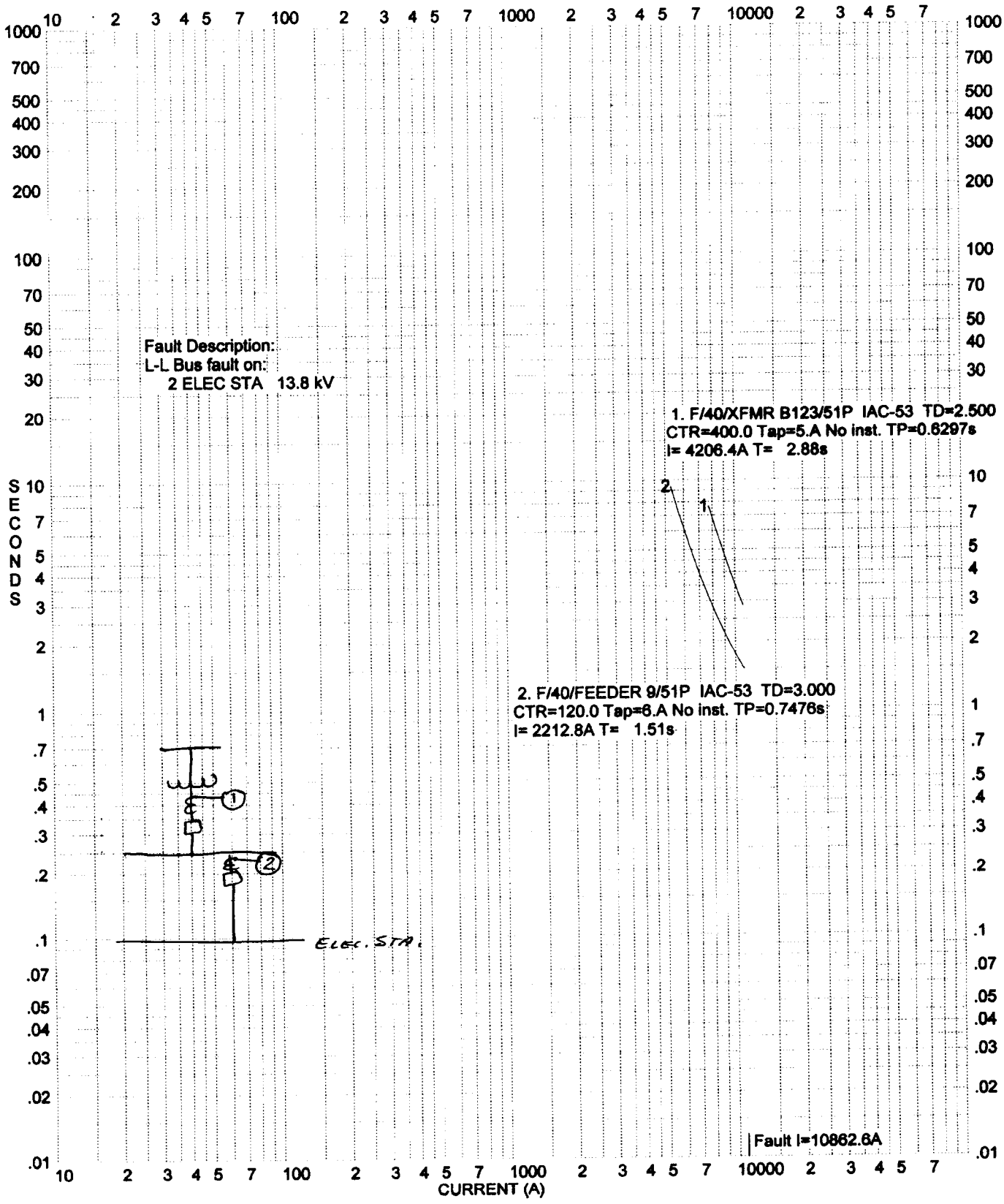
	TIME-CURRENT CURVES @ Voltage 13.8kV	By JJB
For	Coordination between Feeder 3A and Transf. Neut. OC at Summer St.	No. 1 Present
Comment	Miscoordination Exists	Date 3/18/00



TIME-CURRENT CURVES @ Voltage 13.8kV		By JJB
For Coordination between Feeder 9and Transf. Neut. OC at Summer St.		No. 1 Present
Comment Miscoordination Exists		Date 3/18/00



	TIME-CURRENT CURVES @ Voltage 13.8kV	By JJB
For	Coordination between Feeder 3A and Transf. Phase OC at Summer St.	No. 3 Present
Comment	Coordination Exists	Date 3/18/00



	TIME-CURRENT CURVES @ Voltage 13.8kV	By JJB
For	Coordination between Feeder 9 and Transf. Phase OC at Summer St.	No. 4 Present
Comment	Coordination Exists	Date 3/18/00

Appendix E
Proposed Relay Setting Sheets

Relay Setting Revision Request

Station: 40-Summer Street **Circuit/Equipment:** Transf. Sec. Breaker B123

DOC: FG&E DATE: March 17, 2000 Eng: DRC Tester: _____

Relay Information

Relay Type: IAC53 MFG: GE Device ID: F/40/B123/51

Style # _____ Serial # _____

Previous Setting

CT Ratio (/1): 400 VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Delayed Curve Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase	5	2.5	2000	5				
Inst.								
Ground	0.8	5	320	0.8				
Inst.								

New (Proposed) Setting

CT Ratio (/1): 400 VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase	4	5	1600	4	3	4800	12	2.579-3.152
					5	8000	20	1.188-1.452
					10	16000	40	0.667-0.815
Inst.								
Ground	1.2	10	480	1.2	3	1440	3.6	5.711-6.98
					5	2400	6	2.616-3.198
					10	4800	12	1.441-1.761
Inst.								

NOTES: 1.) Fill-in any missing relay information and previous relay settings in the spaces provided.
2.) After completing the above changes return this sheet to Engineering (PC&M Dept.).

Relay Setting Revision Request

Station: 40-Summer Street **Circuit/Equipment:** Feeder 3A

DOC: FG&E DATE: March 17, 2000 Eng: DRC Tester: _____

Relay Information

Relay Type: IAC53 MFG: GE Device ID: F/40/Feeder3A/51-51G

Style # _____ Serial # _____

Previous Setting

CT Ratio (/1): 120 VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase	6	3	720	6	3	2160	18	1.418-1.733
					5	3600	30	0.673-0.823
					10	7200	60	0.394-0.482
Inst.								
Ground	2	7	240	2	3	720	6	3.623-4.428
					5	1200	10	1.700-2.078
					10	2400	20	0.938-1.146
Inst.								

New (Proposed) Setting

CT Ratio (/1): _____ VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase					3			
					5			
					10			
Inst.								
Ground					3			
					5			
					10			
Inst.								

NOTES: 1.) Fill-in any missing relay information and previous relay settings in the spaces provided.
2.) After completing the above changes return this sheet to Engineering (PC&M Dept.).

Relay Setting Revision Request

Station: 40-Summer Street **Circuit/Equipment:** Feeder 9

DOC: FG&E DATE: March 17, 2000 Eng: DRC Tester: _____

Relay Information

Relay Type: IAC53 MFG: GE Device ID: F/40/Feeder9/51-51G

Style # _____ Serial # _____

Previous Setting

CT Ratio (/1): 120 VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase	6	3	720	6	3	2160	18	1.418-1.733
					5	3600	30	0.673-0.823
					10	7200	60	0.394-0.482
Inst.								
Ground	2	7	240	2	3	720	6	3.623-4.428
					5	1200	10	1.700-2.078
					10	2400	20	0.938-1.146
Inst.								

New (Proposed) Setting

CT Ratio (/1): _____ VT Ratio (/1): _____

	Setting		Pick-up		Test Points			
Unit	Tap	Time Dial	Primary Amps	Sec. Amps	Tap Multiplier	Primary Amps	Sec. Amps	Operating Time (sec.)
Phase					3			
					5			
					10			
Inst.								
Ground					3			
					5			
					10			
Inst.								

NOTES: 1.) Fill-in any missing relay information and previous relay settings in the spaces provided.
2.) After completing the above changes return this sheet to Engineering (PC&M Dept.).

Nockege Breaker 1A/113

Configuration Settings

Phase CT Ratio	200	Alt1 Dis/Enb	Enable
Neutral CT Ratio	200	Alt2 Dis/Enb	Enable
VT Ratio	115	MDT Mode	Disable
VT Connection	120V Delta	Cold Load Time Mode	Seconds
Pos Seq. Reactance/Mi.	0.001	Zone Sequence	Disable
Pos Seq. Resistance/Mi.	0.001	Target Display Mode	Last
Zero Seq. Reactance/Mi.	0.001	Local Edit	Enable
Zero Seq. Resistance/Mi	0.001	Meter Mode	KWHr
Line Length Mi.	100	LCD Light	On
Trip Failure Time	18	Unit ID	Nockege 1A/113
Close Failure Time	18	Demand Meter Constan	15
Phase Rotation	ABC	LCD Contrast	16
Protection Mode	Fund	Change Test Password?	No
Reset Mode	Instant		

Nockege Breaker 1A/113

Primary Settings

51P Curve	Recloser Curve	
51P Pickup A	2.1	
51P Time Dial	1.1	***Set Point: 0.075s @ 11.5 X Pickup***
50P-1 Curve	Disable	
50P-2 Select	Disable	
50P-3 Select	Disable	
46 Curve	Disable	
51N Curve	Inverse	
51N Pickup A	1.5	
51N Time Dial	1.4	***Set Point: 0.41s @ 6.0 X Pickup***
79 Reset Time	10	
79 Select	NA	
79-1 Open Time	Lockout	
79 Cutout Time	Disable	
Cold Load Time	Disable	
2-Phase 50P	Disable	
67P Select	Disable	
67N Select	Disable	
81 Select	Disable	
27 Select	Disable	
79V Select	Disable	
59 Select	Disable	